characteristic impedance of about 100 ohms and the wider lines (75) having a characteristic impedance of about 50 ohms, and the center feed line (78) having a characteristic impedance of about 37 ohms, resulting in a beamwidth of approximately 16 degrees.

7. The seventh item to be described is an array combining broadside and Yagi-Uda techniques. The array can take many different forms. Two particular embodiments are described here.

The first embodiment, shown in Figure 10, comprises three or more antenna substrates (7c, 7d, and 7e) and one feed substrate (7f). Substrates 7d and 7e form the broadside array described in the previous part. Substrate 7c has positioned on it a number of enlarged versions of the parasitic elements described in part 3, with spacings equal to that on substrate 7d, with each element on 7c serving as a reflector for the corresponding element on 7d. Substrate 7e has positioned on it a number of smaller versions of the parasitic elements described in part 3, with spacings equal to that on substrate 7d, with each element on 7c serving as a director for the corresponding element on 7d. Additional substrates with director elements of the type used in 7e can be added to extend the Yagi-Uda array effect.

The second embodiment, shown in Figure 11, comprises a number of single substrates (7g), each containing a Yagi-Uda array of the type shown in Figure 5. The individual arrays are placed such that the substrate planes are parallel but displaced, and distributed along an axis perpendicular to both the individual array axes and the redcued size printed dipole antenna elements themselves. A feed substrate (7h), substantially identical to the type described in part 6 and shown as 7b in Figure 8, is used to feed the individual arrays with approximately equal amplitude and phase, although the amplitudes could be tapered by modification of the feedline widths.

In both cases, the result is to obtain increased gain by combining the Yagi-Uda effect with the broadside array effect. Again, a narrow vertical fan beam can be obtained due to the broadside array, while the Yagi-Uda arrangement increases the forward gain and yields a high front-to-back ratio.

8. While the present invention has been described with reference to a few specific embodiments, the description is illustrative and is not to be construed as limiting the invention. Various modifications may occur to those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims.

What is claimed is:

(1) A reduced size printed dipole antenna element comprising:

(a) A dielectric substrate,

(b) Two conducting patches on one side of said dielectric substrate,

(c) a conducting strip, narrower than the patches, connecting the two said conducting patches, with a feed point at the center,

(d) Slots cut into said conducting patches to effectively extend the length of the said conducting strip, and

(e) A second conducting strip on the reverse side of said dielectric substrate, forming a parallel strip transmission line with said conducting strip and connected to said conducting patches through the use of via holes in said dielectric substrate.

(2) A reduced size printed monopole antenna as in claim (1) further comprising a mounting on a ground plane, with said conducting strip driven and said second conducting strip connected to said ground plane.

(3) A parasitic reduced size printed dipole antenna element comprising:

(a) A dielectric substrate,

(b) Two conducting patches on one side of said dielectric substrate,

(c) a conducting strip, narrower than the patches, connecting the two said conducting patches; and

(d) Slots cut into said conducting patches to effectively extend the length of the said conducting strip.

(4) The parasitic reduced size printed monopole antenna as in claim (3) further comprising a mounting on a ground plane.

(5) A Yagi-Uda type directional array comprising:

(a) Any number of parasitic reduced size printed dipole antenna element of claim (3); and
(b) the reduced size printed dipole antenna of claim (1);

whereby number of parasitic reduced size printed dipole antenna element and said reduced size printed dipole antenna are positioned on a substrate.

(6) A broadside array comprising;
(a) a first substrate having any number of reduced size printed dipole antenna element; and
(b) a second substrate with a feed structure whereby said feedstructure consists of parallel strip transmission lines

whereby said first substrate is perpendicularly connected to said second substrate.

(7) A stacked broad side array comprising:
(a) the broad side array as described in claim (6)

(b)a number of parasitic broad side arrays each comprising a number of the parasitic reduced size printed dipole antenna elements of claim (3) whereby they are positioned on any side of said broad side array.

(8) A stacked array of the Yagi Uda arrays as described in claim (5) whereby said stach comprises of any numbers of said Yagi uda Arrays connected by a second substrate with a feed structure whereby said feedstructure consists of parallel strip transmission lines.